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WEATHER NOTES

A NEW ONE-MINUTE RAINFALL RECORD

Introduction.—During the early morning hours of July 10, 1955, heavy thunderstorm activity occurred over an area embracing several counties just west of the center of Iowa. Associated with one of these storms there was a particularly heavy burst of rain that established a new United States record and possibly a new world's record for the heaviest recorded 1-minute rainfall. Over a period of 1.4 minutes the rate of fall was 0.69 inch per minute. For some shorter periods the rate was considerably greater.

At Opid's Camp, Calif., a storm on April 5, 1926, produced heavy rain that has been evaluated at 0.65 inch per minute [1]. A rainfall of 0.82 inch per minute was reported from Porto Bello, Panama, on November 29, 1911, but the nature of the record leaves considerable doubt about its reliability [2]. Other heavy rainfall records for various periods are listed in reference [3].

The new record rainfall was collected in a 9-inch, single-traverse, unshielded, Universal recording gage that was the property of the U. S. Weather Bureau, but on loan to the Iowa Natural Resources Council. Mr. Lawrence Nahnsen, on whose farm the gage was located, was serving as rainfall observer and operator of the gage for the Resources Council. The farm is 11 miles north of the town of Jefferson, in Greene County, Iowa.

The exposure of the gage is good. A few trees are located about 80 feet north of the gage. Shrubs to the west and south of the gage are at a distance of 32 feet and 24 feet, respectively. The house is 100 feet or more away, in a northwesterly direction, and the barn is even farther removed to the east.

The U. S. Geological Survey has a recording stream gage and sediment measuring station about 5 miles downstream on the East Fork of Hardin Creek, which drains the area over which the heavy rain fell. That agency obtained a very interesting trace of the stream rise associated with this storm.

Evaluation of the Record.—The chart had been on the drum for a period of nearly 10 days before the heavy rainfall was recorded. It was some time after the storm before the heavy rate of fall came to our attention, and by that time it was not possible to reconstruct some of the details relating to the storm. A study of the trace indicates that the clock was running at the time of the heavy rain, although the drum did not appear to be set to the correct time.

From interviews with the observer, and with others living in the vicinity, it appears that the heaviest rain probably fell around 2 or 3 a. m. The trace ends about an hour and a half after the storm. This would suggest that probably the clock had stopped before the chart was changed.

A study of the chart indicates that rain was still falling at an excessive rate at the time the pen was lifted off the chart by the clip holding the chart on the drum. The pen line reappeared on the other side of the clip some 20 minutes later and 0.29 inch higher. At the time the line was lost on the clip, the trace was approaching the clip at an angle of about 11°, showing that the drum was turning. There was nothing in the trace to indicate that the drum movement was restricted as a result of contact of the pen with the clip. The trace developed on previous days, when there had been no precipitation, indicates that the chart was properly mounted on the drum, with the edge uniformly against the flange.

The precise evaluation of so small a record chart with such a steep trace is difficult, and there is a strong probability that there is some error in the values developed by this study. However, every possible precaution has been taken to avoid misinterpretation and to keep the errors of measurement and computation as small as possible.

In order to obtain sufficient enlargement to permit careful study of the record, a Kodachrome slide was prepared of that part of the chart that was of particular interest. (Figure 1 is an enlargement from the slide.) The image of the slide was then projected onto a large sheet of stiff paper that was firmly fastened to the wall at the end of a long hall. On the enlargement the time scale measured 0.43 inch per minute, and the precipitation scale was 35.44 inches per inch of rain. A sharp line was traced through the middle of each appropriate line on the projected image, being particularly careful to follow any minor variations that were apparent in the trace.

A calibration of the gage shortly after the record was established indicated that 1.00 inch of precipitation in the range involved showed an increment of 1.01 inch on the chart. Therefore, a measurement of the ordinate distance of 1.01 inches of rain (35.80 inches) was divided by 100 to obtain the proper spacing for the 0.01 intervals, and rainfall amounts were measured on this basis.

The distances between 20-minute time arcs both prior to and following the heavy precipitation were averaged in computing the mean 1-minute distance, and a scale was prepared showing 0.10-minute intervals.

Readings of vertical and horizontal distance from the starting point were made on the large-scale tracing (to hundredths of an inch) for every 0.10 (corrected) inch of rainfall. Readings were also made, independently for every 0.10 minute (6 seconds). The two sets of readings were plotted on coordinate paper to check for consistency, and were found to agree very well. The measurements were then reduced to amounts and times (table 1).

A two-way table was then prepared showing, for each interval, the elapsed time and the increment of precipitation, as well as the rate of fall per minute for that interval. From this table, it was possible to determine readily the greatest rate of precipitation indicated for any given interval of time.

A plot of cumulative rainfall against time indicates that although heavy precipitation was continuous through the period in question there were two separate intervals during which rainfall was substantially heavier than it was during the rest of the time. Beginning at 0.10 minute after time zero and continuing for 0.20 minute rainfall was particularly heavy. The rate was less for nearly 1 minute, then beginning at 1.30 minutes after time zero another heavy burst occurred, which lasted until the record was terminated by the spring clip 0.20 minutes later. Any 60-second period which utilizes either of these intervals of heavier rainfall shows 0.67 inch per minute. By extending the time interval to 1.4 minutes, it is possible to include both of these periods in one computation to obtain an average rate of 0.69 inch per minute for a 1.4 minute period. Since this rate was maintained for longer than 1 minute, it has been adopted as the 1-minute record.

Synoptic Situation.—On the morning of July 10, a stationary front lay in an east-west line across northern Missouri. There was considerable shower and thunderstorm activity north of the front, and numerous reporting stations measured total rainfall of from 1 to 3 inches during the 48 hours of the 9th and 10th.
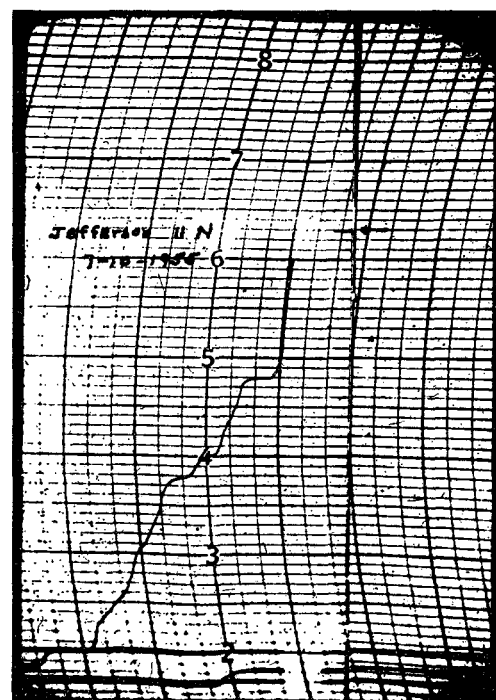

FIGURE 1.—Reproduction of hydrograph record during storm of July 10, 1955.

TABLE 1.—*Rainfall and elapsed-time measurements made from large-scale tracing of precipitation record*

Ordinate [1] (inches)	Abscissa [2] (inches)	Precipitation amount (inches)	Elapsed time (minutes)
0	0	0	0
1.43	.043	.04	.10
3.58	.07	.10	.16
6.45	.086	.18	.20
7.18	.09	.20	.21
10.82	.12	.30	.28
11.20	.129	.31	.30
12.82	.172	.36	.40
14.38	.215	.40	.50
15.45	.258	.43	.60
16.41	.300	.46	.70
17.51	.344	.49	.80
17.90	.35	.50	.82
19.99	.386	.56	.90
21.50	.40	.60	.93
22.84	.430	.64	1.00
25.11	.46	.70	1.07
25.42	.473	.71	1.10
26.86	.516	.75	1.20
28.24	.558	.79	1.30
28.64	.57	.80	1.32
31.80	.602	.89	1.40
32.23	.61	.90	1.42
35.80	.64	1.00	1.49

[1] Measured from 4.99-inch line.
[2] Measured from 7 a. m. line plus 0.520 inches.

Precipitation began about 3 hours before the heavy burst of rain, and accumulated during that time at the rate of approximately 1 inch per hour. It was following this 3-inch fall that the additional inch fell within less than a minute and a half. The storm ended about 20 minutes after the heavy burst of rain.

Although considerable time had elapsed before it was possible for us to make detailed inquiry, an attempt was made to determine the total rainfall measured at nearby points. Best indications are that the storm total increased in an eastward direction to a maximum of over 6 inches in the vicinity of Boxholm, about 12 miles east of the Nahnsen farm. It should be emphasized that these amounts are approximate and are based, in most cases, upon values taken from the memory of farmers living in the area. Only a few written notations were located; in all cases, however, these written records fitted into the pattern described.

Radar Indications.—Radar was in operation during the period of the heavy shower. The equipment was located at the Des Moines airport, about 55 miles southeast of the point where the heavy rain was recorded. The radar showed almost continuous echoes in the Jefferson area from 11 p. m. on the 9th to 2 a. m. on the 10th. Strong echoes between Des Moines and Jefferson after that may have prevented reception of echoes from the Jefferson area. At midnight the tops of echoes in the area were measured at 50,000 feet. Figure 2 is a map of western Iowa upon which is plotted the distribution of radar echoes in the Jefferson area at 11:30 p. m. of the 9th, at 12:30 a. m. of the 10th, and at 1:30 a. m. of the 10th.

Summary.—Although there is some doubt about the exact time at which the heavy rain fell, indications are that the record is correct as it relates to rate of fall, except for the 1-
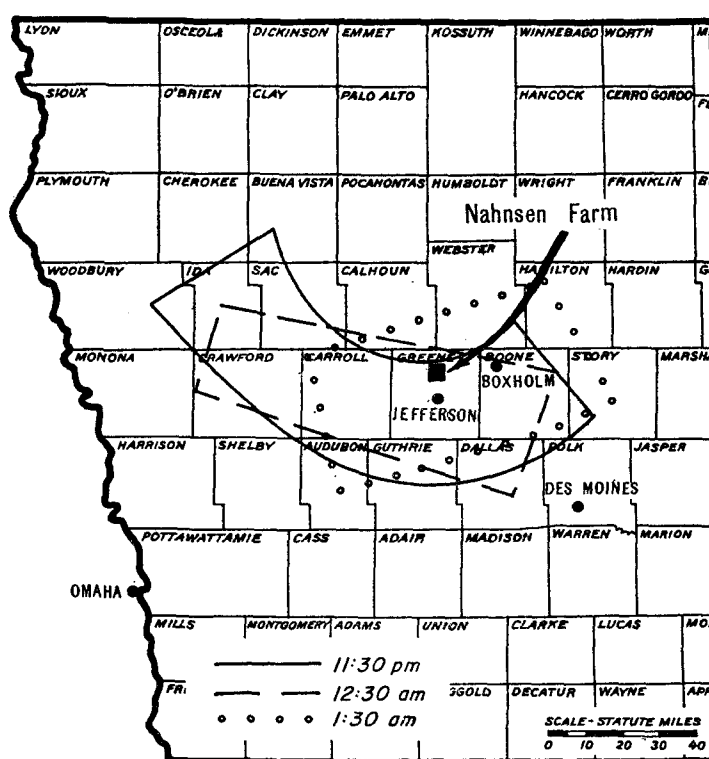

FIGURE 2.—Map of western Iowa showing location of Nahnsen farm and the distribution of radar echoes as seen on the Des Moines radar.

percent correction applied to the amount of precipitation in the interval over which the rainfall was recorded. Correcting for this 1-percent error, the average of 0.69 inch per minute maintained for well over 1 minute establishes a new record 1-minute rainfall for the United States, and a new world's record, if the Porto Bello record cannot be substantiated.

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